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Junk Science and the Jury

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Issue a *venire facias*, and if the draw is a good cross-section of the general public, here is what the sheriff will deliver. Ninety-seven percent of prospective jurors will know that hot air rises.[1] But 40 percent will believe that lucky numbers have a scientific basis.[2] A similar fraction will give some weight to astrology; seven percent of the adult population reports actually changing its behavior because of astrology reports.[3] The *venire* will be split about evenly on whether evolution has a scientific basis.[4] About two in five will believe that rocket launchings can change the weather, and that UFOs occupied by extraterrestrials have visited the earth.[5] About three in five will believe that radioactive milk can be made safe by boiling and that radioactivity is exclusively man-made.[6] One in 11 claims actually to have seen a UFO.[7] By their self-assessments, a good number will have "little understanding" of DNA (57 percent), molecules (28 percent), radiation (19 percent) and the process of scientific study (17 percent).[8]

A 1988 science literacy poll, using an extremely elementary factual science quiz to compare scientific literacy in the United Kingdom and the United States, found that "the American public performed only slightly less dismally than the British." Fewer than half of Americans and fewer than a third of Britons know that an electron is smaller than an atom. About the same proportions in each country know that the Earth goes around the sun once a year. "Now, for most of the public not to have caught up with Sir J.J.

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[1] Barbara J. Culliton, *The Dismal State of Scientific Literacy*, 243 Science 600 (1989).

[2] James H. Krieger, *Scientists Seek to Define, Determine Scientific Literacy*, Chemical & Engineering News 37, 38 (June 23, 1986).

[3] Id.

[4] Id.

[5] Id.

[6] James H. Krieger, *Past Decade Shows No Gain In U.S. Science Literacy*, Chemical & Engineering News 24, 25 (Jan 30, 1989).

[7] William Hively, *How Much Science Does the Public Understand?*, 76 Am Scientist 439, 440 (1988).

[8] Krieger, Chemical & Engineering News 37 (cited in note 2).

Thompson, Robert Millikan, Niels Bohr, and all the rest may perhaps be excused on the grounds of the relatively esoteric nature of atomic physics," the U.K. investigator concluded. "But what reason shall we give for the fact that most of the public has not yet caught up with Nicolaus Copernicus and Galileo Galilei?"[9]

Questions of Copernican astronomy, of course, rarely come to court in either country. But a jury that does not know even the most elementary concepts of kinematics and planetary motion is not a jury that inspires confidence about its capacity to assess the health consequences of herbicides or morning sickness medicines. As the U.S. investigator concluded, "[i]n two of the world's oldest and most prominent democracies, at least nine out of 10 citizens lack the scientific literacy to understand and participate in the formulation of public policy on a very important segment of their national political agendas."[10]

So much for specific ignorance on specific scientific subjects. Standing alone, ignorance about DNA or radiation might be correctable in the course of trial. That, after all, is why the pundits and professors are summoned as experts in such numbers and paid more for a few days' testimony than some of them will earn in a semester of regular teaching. Sadly, however, there is reason to suppose that the expensive lectures, so delicately developed through Socratic dialogue on direct and cross, are largely wasted. Worse still, the savvy litigator has good reason to present testimony from the scientific fringes, whether to support the proposition that smoking does not cause cancer, or that a slip-and-fall did.

A 1979 survey found that less than one adult in ten met a first "rather minimal" criterion for scientific literacy—"[firmly] reject[ing] astrology as nonscientific."[11] A 1986 study concluded that "a substantial minority of Americans appear to have some difficulty distinguishing between science and pseudo-science."[12] To the 15 percent of American adults who did not complete high school,[13]

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[9] Krieger, Chemical & Engineering News at 26 (cited in note 6)(quoting John Durant, Deputy Director of the Department of External Studies at the University of Oxford, from his 1988 U.K. study with Geoffrey Evans).

[10] Id at 24 (quoting Jon D. Miller, Director of the Public Opinion Laboratory at Northern Illinois University, which undertook the U.S. survey).

[11] Hively, 76 Am Scientist at 441 (cited in note 7) (quoting from a 1979 survey by Jon D. Miller, Director of the Public Opinion Laboratory at Northern Illinois University, and Kenneth Prewitt).

[12] Jon D. Miller, *Some New Measures of Scientific Illiteracy* 20 (May 28, 1986) (paper presented to the 1986 Annual Meeting of the American Association for the Advancement of Science, Philadelphia, Pennsylvania).

[13] Id at 30.

"the world looks strange and somewhat hostile. This group . . . depends on luck, signs, and leaders to explain the events that occur in our world."[14]

With or without high school, a substantial majority of Americans have only the haziest notion of what real "science" is. Public ignorance about science, in other words, extends to the entire scientific method, the essence of scientific inquiry. Few understand that the strength of science depends on replication, repetition and collective inquiry. Most people, as the chief education officer for the American Association for the Advancement of Science put it, don't understand that science is "not just Einstein out there thinking up things about the world. . . . It's a collective social activity. It's a collaborative activity."[15] Few, in other words, start with any sort of sound instinct for the differences between real science from the mainstream and junk from the fringes.

A 1957 survey, not exactly recent but nevertheless one of the better ones on the subject, asked respondents to give an open-ended definition of scientific study. Answers like "the accumulation of facts" or "looking at things through microscopes" were judged incorrect; correct responses made some mention (in lay language of course) of iterative induction and deduction, hypothesis, verification by experiment, and the formulation of theory. Only one in eight came close.[16] True scientific literacy requires much more, of course: "understanding the scientific method, knowing its common vocabulary, and appreciating its social impact." In 1979, about seven percent of the adult American population qualified.[17] This is one in 14. If you followed that calculation, the next 13 people you meet in a shopping mall won't.

A jury, of course, typically numbers 12. Not just any 12, moreover, but 12 who (as the most cynical put it) aren't even smart enough to get out of jury duty. This is not an auspicious starting point for coming to grips with those wildly popular "frontier" questions of science and technology, questions of such great interest to much of the legal community today.[18]

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[14] Id at 33.

[15] Krieger, Chemical & Engineering News at 37 (cited in note 2).

[16] Hively, 76 Am Scientist at 441 (cited in note 7).

[17] Id at 442 (quoting a 1979 survey by Jon D. Miller, Director of the Public Opinion Laboratory at Northern Illinois University, and Kenneth Prewitt).

[18] The frontier metaphor has become, in recent years, all the rage among legal types. We are struggling with problems at the "frontiers of scientific knowledge," declared the DC Circuit, which apparently coined the phrase. *Industrial Union Department, AFL-CIO v Hodgson*, 499 F2d 467, 474 (DC Cir 1974). See Comment, *Environmental Carcinogenesis:*

I. JUNK SCIENCE[19]

This is particularly true when the frontier is also the habitat of a considerable volume of junk science. Junk science? Why yes, science has its detritus, too. This is not to say that science as a whole is generally unreliable, or often wrong. To the contrary, modern science is remarkably solid on questions of cause and effect. The atom bomb and the polio vaccine are not products of prestidigitation or polemics. Science nevertheless also records a vast volume of error, false starts, misunderstanding and misguided credulity or skepticism. Science is not usually wrong on matters about which there is a mainstream scientific consensus. But individual scientists often are.

There is, indeed, something of a science of scientific error. Scientific error happens. It is known to happen. Sometimes scientific error is systematized, by a band of committed faithful, who go through involved motions of science, publish at length in their own idiosyncratic journals, and conduct symposia attended by the vocal faithful. In *The Higher Foolishness*,[20] published in 1927, David Starr Jordan coined the label "sciosophy" (that is, "shadow wisdom") for the "systematized ignorance" of the pseudo-scientist. Nobel Prize-winning chemist Irving Langmuir itemized some of the features of junk science itself ("the science of things that aren't so") in his classic 1953 lecture, *Pathological Science*.[21] In his

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Regulation on the Frontiers of Science, 7 Envir L 83 (1976); Charles Nesson, *Agent Orange Meets the Blue Bus: Factfinding at the Frontier of Knowledge*, 66 BU L Rev 521, 530-31 (1986); *Baltimore Gas & Electric Co. v Natural Resources Defense Council*, 462 US 87, 97, 103 (1983). Trans-science is the other metaphor of the moment, used for the most part to encourage the embrace of junk science when science of the other variety can't be found. With apologies to Note, *Trans-Science in Torts*, 96 Yale L J 428 (1986).

[19] I provide a broader discussion of the characteristics of "junk science" in Peter Huber, *The Monsanto Lectures: On Law and Sciosophy*, 24 Valp U L Rev 319 (1990). A slightly more polite term, "pathological science," was coined in a famous 1953 lecture by Nobel Prize-winning chemist Irving Langmuir called *Pathological Science*. Irving Langmuir, *Pathological Science* (as edited and transcribed by Robert N. Hall), reproduced and edited in Physics Today 36 (Oct 1989). The classic longer treatment of the subject for the general audience is Martin Gardner's *Fads & Fallacies in the Name of Science* (Dover, 2d ed 1957). Twenty-five years earlier, David Starr Jordan had coined the word "sciosophy" (meaning "shadow wisdom") for the "systematized ignorance" of the pseudo-scientist. *The Higher Foolishness* 14 (Bobbs-Merrill Co., 1927). See also Robert G. Weyant, "Protoscience, Pseudoscience, Metaphors and Animal Magnetism," in Marsha P. Hanen, Margaret J. Osler and Robert G. Weyant, eds, *Science, Pseudo-Science and Society* 77 (Wilfrid Laurier University Press, 1980).

[20] Jordan, *The Higher Foolishness* at 14 (cited in note 19).

[21] Irving Langmuir, *Pathological Science*, Physics Today at 44 (cited in note 19):

equally classic *Fads & Fallacies in the Name of Science*,[22] Martin Gardner provides a psychological profile of the typical junk scientist. More recently, a federal government study has catalogued some of the common characteristics of quack diagnostic and cure movements that persist at the fringes of the medical profession.[23] Epistemology being an imperfect science, no one has yet reduced the definition of junk science (nor its mirror image, real science) to any very precise formula. Nonetheless, junk science is now a persistent syndrome, of uncertain origin, as well recognized in the scientific community as other more conventional pathologies of mind and body.

There remains a powerful incentive, however, to bring to court the bad science that most compellingly supports your otherwise unsupportable claim.

II. THE RIGHT-FIELD SLOUCH

Junk science in the courtroom can go as far as the public's representatives in the jury box are willing to take it. So how does

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1. The maximum effect that is observed is produced by a causative agent of barely detectable intensity, and the magnitude of the effect is substantially independent of the intensity of the cause.
2. The effect is of a magnitude that remains close to the limit of detectability or, many measurements are necessary because of the very low statistical significance of the results.
3. There are claims of great accuracy.
4. Fantastic theories contrary to experience are suggested.
5. Criticisms are met by *ad hoc* excuses thought up on the spur of the moment.
6. The ratio of supporters to critics rises up to somewhere near 50 percent and then falls gradually to oblivion.

[22] See Gardner, *Fads & Fallacies in the Name of Science* (cited in note 19).

[23] Department of Health, Education and Welfare, FDA, *Laetrile—The Commissioner's Decision*, HEW Publication No 77-3056 at xii (1978):

> The proponents don the mantle of science while at the same time traducing the reputable scientists of their day;
> They claim that prejudice of organized medicine hinders their efforts;
> They cite examples of physicians and scientists of the past who were forced to fight the rigid dogma of their day;
> They rely heavily on testimonials and anecdotes as evidence that their remedy is a safe and effective cancer drug;
> They do not use regular channels of communications, such as journals, for reporting scientific information, but rely instead on the mass media and word of mouth;
> Their chief supporters are not people trained or experienced in treating cancer or in scientific methodology;
> They offer a simplistic theory for causation of the disease;
> Their remedy is easy and pleasant, compared with the frightening therapies wielded by orthodox physicians;
> And they claim the mode of administration of a drug and the method of treatment can be learned only from them.

junk science play in Peoria, or, more specifically, in Peoria jury boxes?

The answer is only superficially encouraging. Most juries, most of the time, apparently call the science correctly. But the minority who call things badly have a disproportionately large impact on average awards, and on public perceptions of a legal system gone awry.

Without doubt, juries sometimes accept factual claims that mainstream scientists categorically reject. The catalogue of junk science verdicts is embarrassingly long.[24] And the price list is straight from Tiffany's. Juries have declared, explicitly or by direct implication, that a slip-and-fall in a New York subway station (with the victim landing on his back) aggravated the growth of a preexisting breast cancer, with damages assessed at $22,500.[25] That birth defects have been caused by the anti-nausea drug Bendectin, good for verdicts of $750,000,[26] $1,100,000,[27] $2 million[28] and $95 million.[29] That a progestational hormonal drug used during pregnancy caused "congenital defects" worth $1.5 million.[30] That the

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[24] As Jerry Mashaw notes, "for some reason the system is ignoring the rules of causation—at least as scientifically, and perhaps as legally, understood—in order to let plaintiffs win." Jerry L. Mashaw, *A Comment on Causation, Law Reform, and Guerrilla Warfare*, 73 Georgetown L J 1393, 1396 (1985).

[25] *Sikora v Apex Beverage Corp.*, 282 AD 193, 196, 122 NYS2d 64 (1953) (reversing jury finding of cause), aff'd, 306 NY 917, 119 NE2d 601 (1954). For articles chronicling various reasons why juries overlook facts in order to recompense the plaintiff in a traumatic cancer case, see Rembrandt H. Dunsmore and Melville Roberts, *Trauma as a Cause of Brain Tumor: A Medicolegal Dilemma*, 38 Conn Med 521 (1974); Everett L. Bishop, *Cancer, Trauma, and Compensation*, 32 Southern Med J 302 (1939); George R. Monkman, Gregg Orwoll and John C. Ivins, *Trauma and Oncogenesis*, 49 Mayo Clinic Proceedings 157 (1974); Ben F. Small, *Gaffing at a Thing Called Cause: Medico-Legal Conflicts in the Concept of Causation*, 31 Tex L Rev 630 (1953); Marshall Houts, *Trauma and Cancer: The Proof Still Rests on a Statistical Approach*, Trauma 1 (Aug 1981); George T. Pack, *The Relation of Cancer to Trauma*, Compensation Medicine 5 (Mar 1950); Lionel Sandler Auster, *The Role of Trauma in Oncogenesis: A Juridical Consideration*, 175 JAMA 946 (1961).

[26] *Oxendine v Richardson-Merrell Inc.*, No 1245-82 (DC Super Ct 1983) (jury returns verdict for plaintiff but trial judge enters judgment notwithstanding the verdict), rev'd and remanded, 506 A2d 1100, 1103 (DC App 1986), vacated Memorandum Order (DC Super Ct, Feb 12, 1988), remanded with instructions, 563 A2d 330 (DC App 1989).

[27] *Richardson v Richardson-Merrell Inc.*, 649 F Supp 799 (DDC 1986), aff'd, 857 F2d 823 (DC Cir 1988), cert denied, 110 S Ct 218 (1989).

[28] *Blum v Merrell Dow Pharmaceuticals*, 385 Pa Super 151, 560 A2d 212, 216 (1989).

[29] *Ealy v Richardson-Merrell Inc.*, 1987 WL 18743 (DDC), rev'd, 897 F2d 1159 (DC Cir 1990).

[30] *Barson v Squibb & Sons, Inc.*, 682 P2d 832, 834 (Utah 1984). The verdict was upheld by the Utah Supreme Court, despite the growing scientific consensus that "progesterone [and other hormonal drugs] do not appear to have any significant teratogenic potential." This language is from the 1981 FDA, Bureau of Drugs, Fertility and Maternal Health Drugs Advisory Committee report suggesting modifications to the mandated hormone drug pack-

non-science of clinical ecology, which asserts the existence of something termed "chemically-induced AIDS," is good for a $49 million verdict.[31] That non-soluble plutonium planted by Karen Silkwood in her own urine was worth $500,000 in actual damages and $10,000,000 in punitives.[32] In all of these cases, there is a solid consensus in the mainstream scientific community that there was no causal nexus of the kind claimed by the plaintiff and accepted by the jury. A fall on the back does not, in fact, aggravate breast cancer. Bendectin does not, in fact, cause birth defects. The plutonium found in Karen Silkwood's urine did not pass through her body; one can state with utter scientific certainty that the urine was spiked. And so on down the list.

But there is much more to the junk science problem than the occasional, erroneous verdict. Junk science presents what has been called, in another context, the "zero-infinity dilemma."[33] Perhaps a nuclear power plant accident is improbable, say critics of the industry, but when the really big one comes we lose Pennsylvania. Most of the time things may be very good, but when they're bad, they're horrid. Graph the frequency of the event against its severity and you get a curve with a long tail, slouching languidly out and down toward the right, like Pinocchio's nose, and for similar reasons. The incidence of graver accidents falls steadily, but the consequences rise even faster. A cold-blooded actuary, adept in integral calculus, may be able to reduce the curve to a single number—the "expected" loss per accident or per year—which looks modest. But the Pennsylvanians remain uneasy.

Pathological curves of this kind have become a familiar feature of jury verdicts in recent times. Consider the Bendectin experience. For 27 years, Merrell-Dow Pharmaceuticals manufactured and sold Bendectin, an anti-nausea morning sickness drug used in

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age inserts and warnings. See Howard L. Dorfman, *Junk Science and Hormone Birth Defect Litigation: The Role of the Medical Hypothesis in Product Liability and Regulatory Activities* 5-6 (unpublished manuscript 1989).

[31] *Elam v Alcolac, Inc.*, 765 SW2d 42, 49, 83, 213 (Mo App 1988), cert denied, 110 S Ct 69 (1989).

[32] *Silkwood v Kerr-McGee Corp.*, 485 F Supp 566, 570 (WD Okla 1979), aff'd in part, rev'd in part, 667 F2d 908, 912 (10th Cir 1984), verdict restored, 464 US 238, 245 (1984).

[33] John P. Holdren, *Zero-Infinity Dilemmas in Nuclear Power*, presentation at the Annual Meeting of the American Association for the Advancement of Science, Boston, Massachusetts (Feb 21, 1976), reprinted in *Reactor Safety Study (Rasmussen Report)*, Oversight Hearing before the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, 94th Cong, 2d Sess 357 (1976).

33 million pregnancies.[34] There then came, in the last decade, a cascade of plaintiffs who blamed the drug for causing birth defects. The consensus in the mainstream scientific community is more solid than it has ever been: Bendectin does not, in fact, cause birth defects.[35] Under a rigorous application of the *Frye* rule, which allows experts into court only if their testimony is founded on theories or technologies "generally accepted" as valid among other scientists in the same field,[36] no trial would occur. But suits have been filed in large numbers nonetheless, and tried in considerable number.

Most juries, most of the time, have sided with mainstream science. Eleven hundred claims, consolidated in a single class action, were ultimately resolved in Merrell-Dow's favor—no liability at all.[37] The manufacturer also won jury verdicts on most of the claims litigated individually. But a handful of juries have come out against Bendectin with modest awards. In one early case, for example, a jury decided that the drug did not cause the child's injuries, but tried to award $20,000 for medical expenses anyway.[38] Three other juries issued awards of $750,000,[39] $1,100,000[40] and $2 million.[41] One jury settled on a spectacular $95 million.[42]

The median jury verdict in Bendectin claims has thus far been zero. Indeed, up to the 99th percentile, the expected jury award (if one is to judge from past experience) is zero. Thanks to one outlier verdict, however, the *average* jury award per claim, so far, has been close to $100,000. One more large verdict could double that aver-

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[34] Tamar Lewin, *Pharmaceutical Companies Are the Hardest Hit*, NY Times D1 (Mar 10, 1985).

[35] *Richardson*, 649 F Supp at 803 (citing "now nearly universal scientific consensus" on the safety of the drug Bendectin in throwing out a $1.16 million verdict against its maker).

[36] *Frye v United States*, 293 F 1013, 1014 (DC Cir 1923).

[37] *In re Richardson-Merrell, Inc. "Bendectin" Product Litigation*, 624 F Supp 1212, 1216 n 1 (SD Ohio 1985), aff'd, 857 F2d 290 (6th Cir 1988), cert denied, *Hoffman v Merrell Dow Pharmaceuticals*, 109 S Ct 788 (1989).

[38] Editorial, *The Cause and Defect of Orangemail*, NY Times 22E (Mar 24, 1985); Editorial, *Morning Sickness, Legal Miscarriage*, NY Times A20 (July 30, 1984).

[39] *Oxendine v Richardson-Merrell, Inc.*, No 1245-82 (DC Super Ct 1983), rev'd and remanded, 506 A2d 1100, 1103 (DC App 1986), vacated Memorandum Order, (DC Super Ct, Feb 12, 1988), remanded with instructions, 563 A2d 330 (DC App 1989).

[40] *Richardson v Richardson-Merrell, Inc.*, 649 F Supp 799 (DDC 1986), aff'd, 857 F2d 823 (DC Cir 1988), cert denied, 110 S Ct 218 (1989).

[41] *Blum v Richardson-Merrell Inc.*, No 82-1027 (Pa Super 1987). See also *Blum*, 385 Pa Super 151, 560 A2d 212, 216 (1989), for published report of jury finding.

[42] *Ealy v Richardson-Merrell, Inc.*, 1987 WL 18743 (DDC 1987). The trial judge cut the verdict to $20 million. Id at 18744. The court of appeals overturned the entire award (remanding for judgment notwithstanding the verdict, not for a new trial) in March, 1990. 897 F2d 1159 (DC Cir 1990).

age. But there is no way to know whether it will come soon, or after another one thousand no-liability verdicts, or not at all. In other words, Merrell-Dow now has fairly good information about the median jury award, but the average, so far defined entirely by the size of a single verdict, remains highly speculative. Considering the wild uncertainty of it all, Merrell-Dow's lawyers have proved to be quite good guessers.[43] At one point during the class action they offered $120 million—or roughly $100,000 per claim—to settle the whole thing then and there.[44]

III. Clusters in Court

As the Bendectin record itself clearly confirms, not all jurors are scientifically illiterate—far from it. Nor will all, by any means, embrace pathological science as an excuse to levy a pollution tax or to compel others to underwrite a no-fault, no-cause health insurance program. Nor do most feel so threatened by the unknown, by the loss of control that unexplained disease represents, that they will embrace junk science as a substitute for superstition or demonology. To the contrary, there is every reason to suppose that most jurors take their responsibilities very seriously, that most bring a good deal of calm common sense to the courtroom and that most make reasonably shrewd choices between competent scientific testimony and the other kind.

Most but not all. And when the maverick jury is convened, almost anything can happen. It does. In frontier-of-science tort cases, the wild variation in awards, the wholly unpredictable outcomes, become, so to speak, entirely expected and predictable. The Bendectin pattern is by no means unique.

In suits claiming "sudden acceleration" of Audi 5000's, to pick a second example, one jury finds no defect in design and rejects a claim for $48 million in damages.[45] A second, in New Jersey, ruling on an essentially identical claim, returns a verdict of $14,000 in compensatory damages and $100,000 in punitives—in a case where the driver admits he accidentally depressed both brake and accel-

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[43] Preferring not to guess about such stakes any more, Merrell Dow itself has withdrawn the product from the market. If you suffer from morning sickness, see your lawyer; your doctor no longer has Bendectin to prescribe.

[44] *In re Bendectin Products Liability Litigation*, 749 F2d 300, 302 (6th Cir 1984).

[45] Gail D. Cox, *Mixed Signals Sent by Early Audi Suit Results*, 10 Natl L J 14 (Aug 22, 1988). *Audi AG Wins Lawsuit Claiming Sudden Acceleration Killed Boy*, Associated Press (June 15, 1988).

erator.[46] A third, in New York, attributes sudden acceleration to a design defect in the transmission system; the verdict is overturned by the trial judge and Audi then settles for an undisclosed sum.[47] A California jury returns a $3.5 million verdict on the theory that placement of the brake and gas pedals was defectively designed.[48] Throw in one summary judgment in Audi's favor, and there's the familiar pattern again. Median verdict $0; mean verdict, almost $1 million, high $3.5 million. And one last footnote. When government agencies in Canada, Japan, and the U.S. completed painstaking investigations of the "sudden acceleration" phenomenon, they found no defect whatsoever in the car's engine, transmission, idle control or cruise control.[49]

Litigation against the Ford Pinto follows a similar pattern, with juries returning verdicts that range from an outright finding of no defect to a jury verdict of $125 million.[50] Out of 11 jury trials against the manufacturer of a hypertension drug, MER/29, the manufacturer wins four, the plaintiff wins only compensatory damages in four, and the plaintiff wins punitive damages in three—one is then overturned on appeal and the other two are significantly reduced.[51] At one point late in the company's legal battles over asbestos, lawyers for Manville stage a series of full-scale trials, presenting the same evidence and instructing mock juries according to the modern rules. Verdicts from five such panels range from

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[46] Helen Kahn, *Audi Seeks Supreme Court Ruling*, Automotive News 30 (Sept 11, 1989) (1988 verdict for $100,000 in punitive damages against Volkswagen of America. In 1983, a 1979 Audi 5000 driven by Harold Horowitz crashed through an apartment wall and injured Germaine Gibbs and her three children. The jury attributed 80 percent of the blame to VWoA and 20 percent to Horowitz). See also Cox, 10 Natl L J at 14. Horowitz admitted he accidentally pressed both the brake and accelerator. The trial judge overturned the punitive award but a New Jersey appellate court reinstated it. An application for certiorari is pending before the U.S. Supreme Court.

[47] *Volkswagen's Audi Says New York Verdict Set Aside*, Reuters (June 21, 1988).

[48] Cox, *Mixed Signals Sent by Early Audi Suit Results*, 10 Natl L J 14. An appeal is pending.

[49] Office of Defects Investigation Enforcement, National Highway Traffic Safety Administration, *Alleged Sudden Unwanted Vehicle Acceleration, 1978 through 1986 Audi 5000 Passenger Cars Imported by Volkswagen of America, Incorporated*; Investigative Report ODI Case No C86-01, Washington, D.C.: National Highway Traffic Safety Administration (July 1989).

Note also that the spread in verdicts has nothing to do with the severity of injury; the first Audi verdict finding no defect involved a mother accidentally killing her six-year-old son; the $3.5 million pedal misdesign verdict involved no fatalities. For the juries that find no misdesign, or no cause in fact, severity of injury is, of course, irrelevant.

[50] *Grimshaw v Ford Motor Co.*, 119 Cal App 3d 757, 771, 174 Cal Rptr 348 (1981).

[51] Richard A. Seltzer, *Punitive Damages in Mass Tort Litigation: Addressing the Problems of Fairness, Efficiency and Control*, 52 Fordham L Rev 37, 54 (1983).

no liability at all to a large award of both regular and punitive damages.

We find the pattern again in litigation over polio vaccines—a string of outright victories, an occasional modest defeat ($200,000 in 1974),[52] then a June 1984 blockbuster—$2 million in compensatory damages, $8 million in punitive damages.[53] And again in IUD litigation. The magic numbers thus far in the ten or so jury verdicts against Searle's Copper 7 IUD are, very roughly speaking, median $0, mean $800,000, high, $9 million. In the space of a few years, nearly 800 lawsuits were filed against Searle's Copper 7 IUD. Some 470 were disposed of with no payment or a small settlement. At the conclusion of the first major consolidated trial, involving 17 claimants, a federal judge directed a verdict in Searle's favor.[54] By 1986, Searle had actually been to court for full trials in only ten cases, of which it had won eight.[55] But the cases continued to mount, and so did the expenses.[56] Then came the big one. In September 1988, Searle lost an $8.75 million jury verdict, which included a $7 million punitive award.[57] Searle's corporate owner, Monsanto, promptly lost 10 percent of its value, $750 million dollars, in a single day's trading on the New York Stock Exchange. For a publicly owned company, of course, that's about as close as one can come to almost losing Pennsylvania.

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[52] *Reyes v Wyeth Laboratories*, 498 F2d 1264, 1269 (5th Cir 1974).

[53] *Johnson v American Cyanamid Co.*, 239 Kan 279, 718 P2d 1318, 1320 (1986), aff'd, 243 Kan 291, 758 P2d 206 (1988). The jury verdict was overturned in a 4-3 vote by the Kansas Supreme Court.

[54] *Marder v G.D. Searle & Co.*, 630 F Supp 1087, 1088 (D Md 1986), aff'd without opinion, *Wheelahan v G.D. Searle & Co.*, 814 F2d 655 (4th Cir 1987), as discussed in Michele Galen, *Birth-Control Options Limited By Litigation*, Natl L J 1, 27 (Oct 20, 1986). Judge Young "required the plaintiffs to show first that the Copper 7 can cause PID, ectopic pregnancy and perforation of the uterus before he would hear testimony on whether the IUD caused the women's injuries." He ruled that the preponderance of the evidence standard required a showing that the risk of the claimed injuries was at least doubled by use of the Copper 7. Medical testimony revealed risk factors no greater than 1.9; the judge thus concluded the plaintiffs failed to meet their burden. The case was later affirmed by the Fourth Circuit without opinion.

[55] Ellyn E. Spragins and William B. Glaberson, *Searle Staring at Some Long Days in Court*, Business Week 35 (Feb 17, 1986).

[56] Searle spent $1.5 million defending just four cases that it won outright; the several hundred million dollars in legal expenses that Searle faced were hundreds of times its annual profit on the device. Elizabeth B. Connell, *The Crisis in Contraception*, Technology Rev 47, 51 (May/June 1987); Anastasia Toufexis, *Birth Control: Vanishing Options*, Time 78 (Sept 1, 1986).

[57] Stuart Taylor, *Thomas Henderson*, Am Lawyer 129 (March 1989). Searle is appealing.

What's going on here? How is defeat now and again snatched out of the gaping jaws of victory? By accident. If we pick children at random and check for leukemia, here and there we will find clusters of disease. It happens whether or not there is a power line, a chemical dump or a bowling alley in the neighborhood. Clusters are a feature of random draws from heterogeneous populations—if you don't find clusters, you can be quite sure the draw was not random, or the population not heterogeneous.

For present purposes, the point can be stated more simply. Random jury draws do not guarantee "average" juries. The selection process itself, commendable though it may be, does not change the prejudice or levels of ignorance, regrettable though they may be, of those selected. Random draws do not produce random panels any more than random card deals guarantee 4-3-3-3 hands at bridge. So one must expect clusters in juries as well. Now and again, a jury box filled at random will contain a majority of jurors ready (for one reason or another) to embrace the most errant scientific nonsense.

How often? It depends on how many of us are scientifically illiterate, how many are willing to brush over scientific facts to advance other purposes in court, how many are so distressed by the randomness of disease that we will embrace even spurious science to restore our psychological equilibrium. But the numbers are not encouraging. If only one in three is scientifically illiterate (and by stricter definitions, the correct number is over 90 percent), if only one in three just wants to tax polluters or help out the injured, if only one in three have minds that cannot accept the notion that some terrible things happen utterly at random, many juries will be highly susceptible to the claims of junk science.

In the jury box, as elsewhere, simple majority voting amplifies any initial imbalance that may be present. If 51 percent of the voters are democrats who vote together, they will control 100 percent of all elected offices. If people who are scared of everything—or of nothing—occupy seven seats on the 12-member jury, their biases will control all up-or-down votes, on subsidiary questions that determine liability, and on all the imponderables of awarding damages.

Is there no protection against the cluster problem among juries? The only one is to move away from the random draw. Challenges, peremptory or for cause, can't really help so long as each side exercises them equally. Non-random selection, which used to be the norm, can help considerably—but the truly random draw for juries is in great favor these days. But as we work to make the

jury draw more random, more representative of the true variability of the population at large, we increase the likelihood of rump juries and maverick awards. For all their other faults, systematically biased jury pools will produce more uniform, more systematically predictable juries. Truly random jury selection may increase justice globally, but it reduces it locally. Case-to-case variability will increase, not decrease.

But won't the "average" verdict be more just? No. Justice is not averageable, and jury verdicts most certainly aren't.[58] This is obvious in criminal justice: one wrong conviction does not average out with one wrong acquittal, even though justice required one of each, as in fact delivered. There is no reason to suppose that averages work any better in the civil justice system. Either Bendectin causes birth defects or it doesn't. Whichever side you believe on the toxicity of Bendectin, a median jury verdict of $0, a mean of $100,000, and a high verdict of $95 million cannot be just.[59]

In civil liability, the average height, weight or I.Q. of jurors will be closer to the population's average if jurors are selected at random. But average awards will not track anything at all. They are likely to be different—and higher—for smaller juries, which give fuller play to individual eccentricities, than for larger ones. The highest possible average award will be the average of a large number of juries of one. No matter how persistently the majority of juries vote for no award, the jury on a frolic can vote for something arbitrarily large, and thus move the overall average to any point desired.

A compensation system in which many lose small but a few win very big is called a lottery. The term has been used too often and too freely in recent descriptions of the civil justice system, and plaintiffs' lawyers respond, with some justification, that very large awards are sometimes justified by very grave injuries. So they are, if the injuries are in fact attributed to the right cause. But an antimiscarriage drug, or a car's transmission, or fiber insulator is either "defective" in its design or it is not. If we see wild variation in verdicts, with solid findings of no misdesign at one end and large punitive verdicts for reckless misdesign at the other, the one place

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[58] Walter Olson, *The Litigation Explosion* (forthcoming), offers the most compact gem on average justice: " 'When I was a young lawyer,' runs the old line, 'I used to lose a lot of cases I should have won. Now that I'm an old lawyer, I win a lot of cases I should have lost. So, you see, there is justice in the system as a whole.' "

[59] We may quickly address the objection that perhaps Bendectin just caused one really big injury in one instance. The science and junk science offered in all the cases was essentially the same; many of the injuries were also similar.

where we can be certain there is a defect is in the legal system itself.

IV. The Boggle Factor

The statistics of clusters help to explain why now and again a jury will simply call the science all wrong, but there is something more to the junk-science dynamic than that. What is intriguing about the right-field slouch, the zero-infinity dilemma, is not that an occasional verdict is wrong, but that the wrong verdicts can be so spectacularly large. We know that selling the facts of junk science is not always easy. We also know that when an occasional sale is made, the markup can be exceptionally high. The thinner the science, it appears, the greater the damages are likely to be if and when a jury finally bites.

Why should this be? First, junk science often has sweeping implications for large populations. As Irving Langmuir noted, the first common characteristic of "pathological science" is that "[t]he maximum effect . . . observed is produced by a causative agent of barely detectable intensity, and the magnitude of the effect is substantially independent of the intensity of the cause."[60] Thus, arbitrarily small exposure levels—a single plutonium atom, vanishingly small levels of formaldehyde, unimaginably weak excitations from electric or magnetic fields—are quite sufficient, the junk scientist maintains, to trigger a cascade of illness. The smallest measurable exposures can be blamed for the most grave and far-reaching effects.

All of which means that junk science can lend weight to the claims of arbitrarily large numbers of plaintiffs. Three-and-a-half million Vietnam veterans, their families and children. Not just asbestos installers, but virtually every citizen of the country who may walk through a building, or pick up a hair dryer, or apply car brakes that contain some asbestos. Not just carpenters constantly exposed to high levels of formaldehyde, but anyone who buys wooden furniture, particle board sub-flooring, panelling, prefab walls, new clothing, new carpeting or furnishings, or a new bed.[61] Junk science has the power to trace out these consequences, yea, even unto the tenth cousin of exposure, the tenth generation consequence. A cast of thousands, in court as in the movies, makes for

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[60] Irving Langmuir, Physics Today at 44 (cited in note 19).

[61] See Sherry A. Rogers, *Diagnosing the Tight Building Syndrome or Diagnosing Chemical Hypersensitivity*, 15 Envir Intl 75 (1989). Rogers works at the Northeast Center for Environmental Medicine, Syracuse, New York.

potentially staggering gains or losses, regardless of the quality of the script.

The diseases addressed by junk science can be almost as numerous as the claimants. The clinical ecologists, for example, point to miniscule exposures to environmental pollutants as the cause of depression, irritability, mood swings, poor concentration, poor memory, fatigue, diarrhea, constipation, cramps, gas pain, sneezing, nasal congestion, asthma, headaches, and muscle and joint pain.[62] Indeed, their claim is that trace pollutants depress the immune system, the immune system is vital to fighting off illness of every description, and thus quite literally *anything* can be blamed on the pollutant of the moment—including cancer, of course. With faces quite straight, two founders of modern clinical ecology dedicate their work to "all patients who have ever been called neurotic, hypochondriac, hysterical, or starved for attention while suffering from environmentally induced illness."[63] It's the snake oil salesman all over again, in reverse. Some people sell nostrums that allegedly cure everything, from baldness to syphilis; the modern-day peddler diagnoses everything, from baldness to AIDS, and blames it on snakes. Someone else's snakes, of course.

Now imagine for a moment that some manufacturer of felt-tipped pens, carpets or industrial plastics really *was* responsible for a community wide epidemic of depression, irritability, diarrhea, and, oh yes, cancer too. The occasional credulous jury doesn't have to imagine, it believes. You never know just when you'll run across this kind of jury. But when you do, the damages assessed may obviously be enormous.

Then come matters of pain and other intangible losses. Junk science claims most often involve risks that rank high on the scale of ignorance and dread. Some claimants backed by the clinical ecologists will have nothing worse than constipation, but others will have cancer. One way or another, junk science diagnostics almost always sweep in some randomly horrible and insidious disease along with the hypochondriacs' common catalogue of the banal. So when a jury does occasionally bite, almost anything is possible in the calculation of damages. Certainly the jury that accepts junk science is likely to be sympathetic to claims for intangi-

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[62] Id.

[63] Quoted in Elliot F. Ellis, *Clinical Ecology: Myth and Reality*, Buffalo Physician 17, 25 (Feb 1986) (quoting T.G. Randolph and R.W. Moss, *An Alternative Approach to Allergies: The New Field of Clinical Ecology Unravels the Environmental Causes of Mental and Physical Ills* (Lippincott & Cromwell, 1980)).

ble losses—distress, cancerphobia, pain and suffering, and the like. It is surely a distressing thing to suffer years of illness only to find, in the end, that you were being silently attacked all along by your felt-tipped pens or the chemical factory upwind.

Finally, and perhaps most perversely, the defendant who most stubbornly contests the scientific merits is also the defendant who may be the most likely victim of a gargantuan punitive award. Suppose today's jury happens to be the one that will be persuaded, scientific merits notwithstanding, that this caused that. The injuries in question may be particularly nasty, or notable simply because they are so wide-ranging in the local populace. But has the Mammoth Chemical Company confessed? Is it the least bit contrite? Not at all. In the face of persuasive evidence—persuasive to this particular jury at least—Mammoth stubbornly insists that Bendectin is harmless, that the Audi 5000 was not misdesigned, that the pollution did not cause a Missouri epidemic of constipation, colds, and cramps, that the slip-and-fall in the New York subway did not cause the cancer. For this jury, the one that is persuaded, the thought of exemplary damages springs to mind.

The verdicts against Audi, for instance, were based, entirely or in large part, on junk science indictments of the car's acceleration mechanisms. The first major Audi verdict involved a woman who had asked her young son to step out of the car to open the garage door. She then accidentally put her foot on the accelerator rather than the brake, panicked and crushed the child. Suppose this jury happens, by the luck of the draw, to be one peculiarly susceptible to junk science indictments of the car's transmission, electronic idle or cruise control. A six-year-old child is dead. The mother is almost insane with grief. A grave defect in the car, or so this jury is persuaded, is the cause. And in the face of all this, Audi brazenly insists that it is blameless. What does this call for in punishment? If the Pinto history is any guide, perhaps $100 million. In fact, Audi won this particular case; the distraught mother had blurted out the truth to the investigating police officer at the time of the accident, before her recollection could be refreshed in anticipation of trial. But Audi ran into a more believing jury soon thereafter, and disaster was averted only by sheer luck: the bad jury happened to be drawn in a case where the actual injuries were slight, amounting to only $14,000 in property damage. But this jury also concluded that seven-fold punishment was in order, and added on

$100,000 in punitive damages for that purpose.[64] The trial judge overturned the punitive award; a New Jersey appellate court reinstated it.[65] What would Audi have paid if this particular jury had been drawn for the six-year-old child?

To be sure, many factors other than junk science expand the range and volatility of verdicts. Pain and suffering, hedonic damages, loss of consortium, loss of society and other intangible losses are not controlled by any stable or predictable metric. Junk science is especially potent, however, because it goes not merely to the measure of damages but to the core issue of liability itself, and because it invites the credulous mind to wander toward the frontiers of the imagination in assessing how many people were injured in how many different ways. It is unsurprising, and perhaps even tolerable, to find variation in wrongful death awards against drunk drivers who actually do kill pedestrians. But verdicts that range from zero to any arbitrarily large amount against chemical companies that do not, in fact, cause "chemically induced AIDS" are quite another matter.

How much is a corporation likely to pay if the jury just happens to miss the science completely and accept that Mammoth Corporation is responsible for a local epidemic, or Audis blasting off like space shuttles, ailments of every conceivable description affecting virtually all Vietnam veterans, or formaldehyde-induced dementia that causes a woman to "laugh[] and rock[] in the chair and [think she is] Jesus' wife."[66] One defendant waited for the verdict in a clinical ecology case and learned the answer was $49 million;[67] others have preferred to settle for tens or hundreds of millions of dollars rather than find out for sure. How much is a defendant likely to be assessed when a jury embraces junk science simply because it desires to assess an ad hoc pollution tax? We know that one jury settled on $16 million as an appropriate fee—the same jury that found no actual harm had been caused.[68] When junk science is on the table, stratospheric damages are always possible. Such awards may be infrequent, but the mind boggles at their possible size. A boggled mind is a mind ready to talk

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[64] Cox, 10 Natl L J 14 (cited in note 45). This case remains on appeal.

[65] *Audi Hits a Brick Wall in Old Acceleration Lawsuit*, Autoweek 10 (Mar 6, 1989).

[66] See Rogers, 15 Envir Intl at 75 (cited in note 61).

[67] *Elam*, 765 SW2d at 83.

[68] *Kemner v Monsanto*, No 80-L-970 (Cir Ct, St. Clair Cty, Ill 1987). This case is described in two reports in the New York *Times*: *Marathon Trial on Dioxin Spill Nears End in Illinois After 3.5 Years*, NY Times A15 (Aug 19, 1987); and *Monsanto Liable in '79 Dioxin Spill*, NY Times A12 (Oct 23, 1987). Monsanto has filed an appeal, which is pending.

settlement. For plaintiffs' lawyers, the boggle factor pays a lot of rent.

V. THE PROFIT CURVE

The boggle factor may explain why so many trial lawyers have been notably philosophical about the right-field slouch that characterizes junk science litigation.[69] To put the matter plainly, the right-field slouch is a very good thing for lawyers—and an equally bad thing for insurers, of course, whose losses coincide pretty much with plaintiffs' gains.[70]

Even a perfectly symmetric verdict curve, where median and mean are exactly the same, may have a large standard deviation, a large variance in awards. Skewed curves are different, in that they have both variation and asymmetry. The curves are skewed—the median and the mean (or "average") are very different. If the tail drops off slowly enough, the curve can be quite pathological. It may be impossible to ascertain the "average" award in any reasonable number of trials.[71]

Jury verdicts in civil litigation will almost inevitably be skewed to some degree, because jury awards always have a lower limit, but rarely an upper. Every new case has a new jury, and one jury's finding is not binding on the next's, so however modest previous verdicts were the next one may still be munificent. Among juries that find liability, each makes its own call on damages for intangible losses and punishment. In cumulative polls, the more times a question is asked, the more likely the answer will converge on some representative mean. But jury verdicts are cumulative

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[69] For a notable exception, however, see Rheingold, *It's Time to Change the System on Junk-Science, Quack-Expert Issues*, Manhattan Lawyer 13 (Nov 1-7, 1988).

[70] It has been recognized for some time that junk science has very different implications depending on just where you're sitting in court. The issue is not always cleanly bifurcated along plaintiff-defendant lines, of course; in the past, tobacco companies invoked very dubious science as a backstop to their far more plausible defense of informed choice. But most often, junk science represents opportunity for plaintiffs, and for plaintiffs' representatives, and potential disaster for defendants, and defendants' insurers. Causation has become "the main line of defense of the established order," observes Jerry Mashaw in *A Comment on Causation, Law Reform, and Guerrilla Warfare*, 73 Georgetown L J at 1395 (cited in note 24). Many "plaintiffs' victories in the courts are based on shockingly bad science. Good science in the courts, of course, favors defendants in toxic torts litigation . . . . [T]he defense bar's faith in scientific method—as it clings to the best techniques of epidemiology and toxicology as the basis for determining facts in tort suits—makes perfect sense." Id.

[71] This will certainly be true if the area under the curve—the expected loss per trial—is not finite. In real life, of course, other factors like bankruptcy cut off liability at some point or another. From the point of view of a defendant, any limit of the same order as the net worth of the company can be viewed as infinite.

only in the dollars paid, not in the accuracy of the overall message. One hundred wise verdicts can be utterly dwarfed by one extremely foolish one.

Of course, the skew is not always as dramatic as in the Bendectin cases. One might expect awards in run-of-the-mill road accidents that result in a single class of injury—a broken leg, say, or a single fatality—to be better behaved. Workers' compensation awards, administered under liberal standards of cause and effect but strictly bounded in amount by damage schedules, may tend to be skewed the other way, with the median award close to the maximum allowed, the average pulled lower by the rare case where compensation is denied. The Bendectin-like pattern, the dramatic right-field slouch in jury awards, happens, but it is not the norm. It is of considerable practical importance, however—generally a very good thing for lawyers, and a very bad thing for insurers.

Plaintiffs' lawyers can profit handsomely from the disorder and inherent unpredictability that such curves reflect. All that plaintiffs' lawyers need to cash in on the right-field slouch are persistence and staying power. Even if nine out of ten juries reject junk science, the tenth jury that awards $95 million will return a tidy profit to lawyers operating on 30 percent contingency fees, or will if such jury verdicts are allowed to stand. As I have argued, it doesn't take anything like "most" juries to keep this kind of litigation churning in court. Perhaps even nine out of ten juries will correctly conclude that a morning sickness drug is harmless, or passes a risk-utility test despite its real risks. However, a contingency-fee plaintiff's lawyer can bring a case for $30,000 out-of-pocket, and the tenth jury may award $95 million for a birth defect. At these odds, there will be a lot of litigation, unless, once again, the jury odds are radically altered by jnov's and appeals. Indeed, at a 30 percent contingency fee, the break-even point for litigating this kind of case requires a successful sale to only one jury in a thousand. If just one in a hundred bites, and you can file cases at a steady clip, you get very rich. So it will not do to defend the jury by insisting that most juries will get things right, even if the statement is true. It will not do to say that most juries are sincere and well-intentioned, even if that too is true. Huge, completely unwarranted transfers of wealth can still result by waiting for the cluster that gets it all badly wrong.

Staying power is all important in converting even a favorable-odds gamble into certain profit. Lightning will rarely strike the first time in court; the odds greatly favor a series of outright losses, or merely modest victories, first. Filing any kind of case requires

time and cash, and if either runs out too soon, the firm goes under. Like other kinds of speculators, then, Bendectin-curve players must be able to hold the cards, meet the raises, and stay in the game. This is indeed the one really big hurdle on the plaintiffs' side of things. Theoretical calculations notwithstanding, no established plaintiffs' law firm will play one-in-a-thousand, or even one-in-a-hundred odds waiting for the big win, even if when it comes the win will pay off earlier losses many times over. In practice, few firms are much interested in odds that are much worse than ten-to-one against a big payoff, and then only if many of the other cases can be expected to cover their costs and yield some modest return along the way.

Without doubt, plaintiffs' lawyers know how to play the Bendectin curve for profit. They rarely care to discuss the stochastic aspects of their profitability, of course. But there is one very telling fragment of evidence about how they view their business, and it is in the billing. Almost without exception, plaintiffs' lawyers don't do windows and don't work by the hour. A contingency fee is the standard, non-negotiable arrangement.[72] This alone is compelling evidence that they recognize the wide difference between the mean and the median, and see their principal profit in the mean. The issue may not be analyzed in quite those terms, but that is what it surely comes down to.

For a paid-by-the-hour lawyer, the $95 million verdict is worth roughly the same as the $750,000 case, or the no-liability verdict. Yes, perhaps the jackpot verdict required a few more hours of work, but surely not one hundred times as many. Hourly wages, in short, would separate plaintiffs' lawyers from the bonanza possibilities of the long tail on the verdict curve. From the lawyers' perspective, the compensation curve when you work by the hour looks completely different: there is payment in many more cases (not all, of course, at least if clients may opt for a contingency fee if they prefer), but there are jackpots in fewer. From the lawyers' perspective, everything is much more symmetric. So the median and the mean converge. And in practice, plaintiffs' lawyers will have none of it. The income of successful plaintiffs' lawyers depends on jury statistics, not on hours worked. And that is just the way they want it. So much so that almost all refuse to work on other terms.

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[72] This is a surprising phenomenon in a profession that has been quite free in leveling charges of antitrust conspiracy against others.

In the zero-sum game of litigation, randomly large profits for plaintiffs spell randomly large losses for insurer. Insurance companies can cover deviation much more easily than skew. Put another way, wide variation in awards for similar injuries may reflect badly on the legal process, but the market can usually adjust through insurance. Skew is much less insurable, even with reinsurance in the background, because it is much more difficult to ascertain the average of a highly skewed curve.

The upshot is that as junk science advances, insurance retreats. American insurers today have become notably reluctant to insure contraceptives, vaccines and most forms of environmental pollution. Within limits, it is possible to insure against variation—verdicts that scatter, more or less evenly, to the right and left of some stable average. But the highly skewed, Bendectin-like curve is essentially uninsurable. Insurance ultimately covers the average, not the median, which means that the underwriter must have some way to ascertain the average. In practice, that is next to impossible with highly skewed curves. Of course, the insurer's calculation can be simplified with policy limits and stop-loss clauses; these are indeed used aggressively in the few remaining areas of environmental and pharmaceutical coverage, and in areas like medical malpractice where the right-field slouch is much in evidence. But this is simply another way of saying that insurers can refuse to insure the right-field tail, and that is precisely what insurers have been doing.

What should one make of the fact that settlement rates remain so high, notwithstanding the right-field slouch? Some conclude that litigants are nonetheless reasonably able to anticipate the inscrutable jury and resolve things without it. This is too optimistic. First, overall settlement rates are inflated by the easy cases—fender benders, slip-and-fall fractures (though not slip-and-fall traumatic cancers), and things of this sort. Second, settlement is impelled by other factors. Insured defendants may have the staying power to litigate to the end, but risk the boggle factor if they lose. For contingency-fee plaintiffs' lawyers, settlement pressures rise steadily as cases drag on and out-of-pocket costs rise. Simply stated, plaintiffs' lawyers settle because they fear the median, and, even if wealthy, often lack the time, resources and high-stakes gambling instincts to hold out indefinitely in case after case, waiting for the mean. Defendants and insurers settle because they fear the bet-the-company mean. The fact that many cases, including many junk science cases, are settled does not, then, tell us very much. Settlement is driven largely by counterbalancing though

quite different failures of the legal process: huge delay and expense working against the plaintiff on one side, and wild-card verdicts working against defendants on the other.

Legal speculators and arbitrageurs can profit handsomely from asymmetric disorder of the kind that junk science, with its mind-boggling potential reach, creates better than anything else. For the speculator, the skilled salesman of superstition and conjecture, it is not necessary to have a solid case on all important points or in every claim filed; it is good enough to have a plausible case in some of them. It is not necessary to win all or even most cases filed: a one in ten chance of winning 20 times your stake produces a very comfortable living if the bet is repeated often enough. There is money to be made on liability futures, and good lawyers know it. Not every part of the pig is certain to appreciate. But plaintiffs' lawyers, able to play the odds again and again, are assured a very comfortable living by investing in the hog as a whole.

VI. The Costs of Accidents

Yes, of course, all human institutions, dealing with human problems, are fallible. Yes, a demand for perfection is unrealistic. Plaintiffs' lawyers are often the first to present this argument in defense of the system, junk science verdicts notwithstanding. And the argument is quite valid, though unexpected when it comes, as it does, from people prone to great indignation when imperfections are detected in lawn mowers rather than in lawsuits. Nonetheless, the runaway potentials of junk science in court are a special problem, not to be brushed aside as one of the ordinary and inevitable incidents of human frailty.

A junk science verdict is an accident in court. It is a defective legal product, designed by (at best) incompetent experts, assembled by ill-trained laborers working hastily, under stressful conditions, in the jury deliberation room. The verdict represents a failure of supervision in both planning and production. The packaging is deceptive and the public warning delivered by the verdict misleading, sometimes dangerously so. Costs are misdirected, as are profits. Junk science verdicts encourage excess investment in a socially harmful activity—litigation itself.

The social burdens are not to be underestimated. No one should appreciate that better than modern-school tort scholars, who are committed to reallocating the costs of accidents involving cars and planes, chemicals and contraceptives, football helmets, diving boards, insulators and peanut butter—accidents of every description, it would appear, except accidents in court.

Who exactly bears the costs of accidents in courts? Almost everyone except those most directly responsible for them, which is to say lawyers themselves.

The first and most obvious victims, of course, are those on the losing side of the bad verdicts. Wyeth Laboratories pays for a case of polio caused in fact not by Wyeth's vaccine but by a wild strain of the virus; the taxpayer pays a swine-flu verdict for an illness not in fact caused by the vaccine. Audi loses two-thirds of its U.S. business on the strength of publicity and verdicts about defects that don't exist. The manufacturer of a spermicide, or a safe IUD, pays more than a year of its profits for a birth defect it did not cause. Even if insurance pays, the costs flow back to where they don't belong.

Next in line in the list of junk science victims are consumers-at-large. Law-and-economics apologists for broad liability have always asserted, correctly no doubt, that liability costs come to be reflected in the prices of goods and services, and thus send a message to consumers. This is as true, of course, when the costs are unjustified as when they're justified. With junk science verdicts, as with the other kind, prices rise, production drops, and other consumers are unduly deterred from buying. The Audi 5000, for example, almost driven off the market by junk science lawsuits and their attendant publicity, was an exceptionally safe car, as ranked in subsequent NHTSA fatality statistics for all automobiles. Its successor, the Audi 100—whose sales are vastly lower than they would have been thanks to junk science attacks, in court and out—is safer still; in 35-mph crash tests, instrumented mannequins registered the lowest force ever recorded by NHTSA for any car in this kind of test.[73]

Notwithstanding their victory in court, even the ostensible beneficiaries of junk science verdicts pay a price too. It is no kindness to inform a retirement-age asbestos worker that his problem is asbestos if in fact it's smoking; past exposure to asbestos cannot be altered, but future exposure to tobacco still can be. People who have been told they are victims of chemically induced AIDS, and who have persuaded a jury to that effect, may well persuade themselves. This will be depressing, at the very least, perhaps even psychologically paralyzing. Vietnam veterans who might otherwise have moved beyond their memories and fears to resume a productive life can now sit back as invalids, funded by a legal windfall

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[73] Tom Incantalupo, *Can Audi Turn Around? New Line of Cars Wins High Marks But Few Buyers*, Newsday 58 (Oct 15, 1989).

founded on scientific fantasy. If the placebo effect is real, as it certainly is, so too is its mirror image, hypochondria and iatrogenic disease. Junk science verdicts, in short, may promote and sustain illness even when the electric fields, the microwaves, the trace pollutants or the unmeasurable radioactivity have caused nothing but the verdict itself.

The wreckage of junk science verdicts does not end with the litigants themselves. Verdicts speak to the public at large too, and people tend to believe what the courts say, most especially when they say it with large amounts of money. The casual follower of jury verdicts might easily conclude that most pelvic disease is caused by IUD contraceptives and tampons, most lung disease by workplace dust and fiber, most car accidents by defects in design, most miscarriages, birth defects and cancers by ambient environmental pollution. But they aren't. By far the important keys to safety and good health involve tobacco, alcohol, seat belts, diet and sexual habits—matters very much within the individual's own reach and control. This close-to-home diagnosis may be heartily unwelcome in a liability system obsessed with third-party insurance and the hopeful search for cheaper-cost-avoiders far from the scene. Junk science may cheerfully accommodate the send-the-bill-elsewhere preferences of many courts and juries. But when courts and juries pander to junk science they deliver to the public a dangerously false message.

When we can, we ban such teachings—the teachings of quack diagnosticians and snake oil salesmen—from the doctor's office and the itinerant peddler's pushcart. Falsehood in matters touching on health and safety is investigated by the NIH and prosecuted by the FDA. The public reasons for keeping factual falsehood out of court are much the same. Superstition is the refuge of a primitive tribe. It saps resources, misdirects energy and discourages creativity. It can engender a sense of helplessness and apathy, and prevent people from searching out real causes and effective therapies. Now and again, superstition and its cousins will promote a violent, destructive hunt for remedies in the most bizarre places. Dignifying junk science weakens society for precisely the same reasons that promoting good science in and out of court strengthens it.

Finally, junk science eventually weakens the courts themselves. The truth will out, in the end. Today, all serious students of these subjects recognize the junk science basis for the verdicts against Agent Orange, the Ortho-Gynol spermicide, Bendectin, and in countless cases involving traumatically induced cancer. The pages of *Science* magazine calmly recount the courts' rising suscep-

tibility to junk science claims from clinical ecologists[74] and other fringe experts attacking the U.S. contraceptive industry.[75] The accumulation of junk science verdicts does not bode well for the authority of the courts. In the end, judicial power depends on getting facts right—and on having the public perceive as much. When the real scientists catch up with junk science verdicts, as they inevitably will, courts end up in disrepute.

VII. Stopping Points

The clumsy but direct remedy for the outlier verdict, the right-field slouch, is to cut off the tail. Traumatic-cancer verdicts appear to be losing favor among appellate judges, although partly, it seems, because they are giving way to clinical-ecology verdicts. The runaway Bendectin verdicts have either been overturned on appeal or remain under review. Trial judges in New Jersey and New York overturned design-defect verdicts against Audi. It seems unlikely that a $16 million dollar punitive verdict on top of a $1 compensatory verdict will survive appeal. The $10 million polio vaccine verdict involving a wild strain of the virus was overturned, on other grounds, by the Kansas Supreme Court.

It isn't simply that judges are wiser than juries. It's that a jury can move damages only toward the right, from zero on up, while trial and appellate judges reviewing jury verdicts can, generally, move only back to the left. The worst reviewing judges can do to promote junk science over the resistance of a wiser jury is to empanel another one and hope for worse.[76] The principal power of the second- and higher-tier decision makers, then, is to cut off the tail. In firm hands, this particular pair of scissors can readily prune the verdict-distribution curve into healthier, more evenly proportioned proportion. Appellate review is an asymmetric process, of course,

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[74] Eliot Marshall, *Immune System Theories on Trial*, 234 Science 1490 (1986).

[75] Carl Djerassi, *The Bitter Pill*, 245 Science 356 (1988).

[76] *Scott v. Monsanto Co.*, 868 F2d 786 (5th Cir 1989), for example, involved the claims of 126 plaintiffs against the Monsanto Company. They alleged that Monsanto was liable for their physical injuries, which they claimed resulted from exposure to PCBs. Ten plaintiffs were selected for a "bellwether trial." The trial lasted over two weeks and featured the testimony of over 60 witnesses. The evidence centered primarily on the nature of the plaintiffs' exposure to PCBs and the causal relationship between PCBs and the plaintiffs' ailments. The jury returned a verdict in favor of Monsanto on all plaintiffs' claims. The trial judge granted the *plaintiffs'* request *for a new trial*, which he justified as an attempt to avert a "miscarriage of justice." 868 F2d at 789. An appellate court restored the jury verdict: "We would not expect disagreement between judge and jury upon the integrity of multiple witnesses to be a sound basis for a new trial. . . . We vacate the district court's order for a new trial and remand so that judgment may be entered on the jury verdict." Id at 791-92.

and plaintiffs' lawyers generally hate it. But then defendants' lawyers hate the first round, precisely because it is asymmetric in the other direction, with nothing to gain and everything to lose.

Would we solve the junk science outlier verdict altogether if judges simply displaced the jury entirely, as happens in most civil cases in Britain? One might expect to find a higher overall level of scientific literacy among judges, which would certainly help. And habituated as they are to looking to others for support on matters of law, judges might be somewhat more inclined to go with the larger flow on matters of fact. Regression of the mean toward the median is also likely to proceed more quickly when the decisionmakers are repeat players under steady collegial pressure to conform.

Juries, on the other hand, offer strength in numbers. Other things being equal, singular verdicts are more likely to issue from singular decisionmakers. Cases arising under the swine flu vaccination program, for example, were tried under the Federal Tort Claims Act without juries. Most judges ruled sensibly and soberly, relying on the one solid government study that linked the vaccine to an increased incidence of Guillain-Barre Syndrome ("GBS") for some weeks after the vaccine was administered.[77] Nonetheless, a few judges called the science flamboyantly wrong. One successful plaintiff contracted GBS more than three months after her injection, long after any adverse reaction to the vaccine would have appeared.[78] Another recovered damages for "serum sickness," though there was then, and is today, no serious scientific evidence that the vaccine caused any such malady.[79] In contraceptive litigation, one of the more embarrassing junk science verdicts on the books is a federal bench trial verdict to the effect that a spermicidal jelly caused birth defects.[80] Upheld by the Eleventh Circuit, that ruling

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[77] *Heyman v United States*, 506 F Supp 1145 (SD Fla 1981) (rejecting plaintiff's claim because she attempted to prove her case without epidemiologic evidence; clinicians generally cannot determine "whether a relationship exists between an illness and a preceding event such as a vaccination. . . . [W]ithout at least some reference to epidemiological studies, plaintiff's position that her illness was caused by the swine flu shot amounts to nothing more than speculation"). Id at 1149.

[78] See, for example, *Sulesky v United States*, 545 F Supp 426 (SD WVa 1982). The plaintiff first exhibited signs of GBS more than three months after her injection. She introduced epidemiologic testimony that conflicted with the government report. The confused trial judge turned to the testimony of treating and evaluating physicians, and held for the plaintiff.

[79] *Petty v United States*, 740 F2d 1428 (8th Cir 1984). See, generally, Edmund W. Kitch, *The Vaccine Dilemma*, Issues in Science and Technology 108 (Winter 1986).

[80] *Wells by Maihafer v Ortho Pharmaceutical Corp.*, 615 F Supp 262, 292 (ND Ga 1985), aff'd and mod in part, 788 F2d 741 (11th Cir 1986). Judge Martin Shoob decided that

was ultimately good for $4.7 million in damages.[81] The ruling prompted a New York *Times* editorial titled "Federal Judges vs. Science";[82] the mainstream scientific consensus firmly holds that spermicides do not cause birth defects.

Like juries, judges can be overcome by charitable impulses, which are often quite blatant in workers' compensation cases. Judges, too, may feel the occasional urge to play the environmental ombudsman, imposing a pollution tax here or there, not because anyone's been hurt, but because pollution is unpleasant. Trading a jury for a judge may help by adding some institutional memory and a go-with-the-mainstream mindset in the assessment of junk science. But, on the other hand, replacing 12 decisionmakers with one can amplify individual credulity, dread or misconception. Similar considerations apply, of course, when the debate concerns cutting the size of the factfinding panel down to six rather than to one.

Preventative medicine is better than surgery, however—most especially when surgery is expensive, imprecise and far from predictable. The real solution to the jury-verdict tail is not to amputate it, but to discourage its growth in the first place.

Much can be done to remove the wild cards of dread, compassion and free-lance deterrence from the jury's hands. In the Bendectin class action, for example, Judge Carl B. Rubin of Cincinnati trifurcated the trial, with separate phases to decide cause, liability and then damages, and banned both the word "thalidomide" and visibly deformed children from the courtroom.[83] After listening to 19 experts, the jury found that Bendectin did not cause the birth defects, and that was the end of the matter. A similar procedure worked, more or less, in the first major legal test of the Copper 7 IUD. Judge Joseph H. Young ruled that the plaintiffs would first have to persuade the jury of the general links between the Copper 7 and pelvic disease before presenting any heart-

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the statistical studies offered by experts were "inconclusive"; just what did persuade him was never quite clear. The one study he did cite that investigated a relationship between spermicide use and birth defects had been reviewed by the Food and Drug Administration and had been found to be inconclusive. One of the authors of the study appeared at the trial to warn the court not to construe the study as proving a link between spermicides and birth defects. Larry Doyle, *Contraceptive Jelly—Birth Defect Study Repudiated by its Authors*, United Press International (Dec 11, 1986).

[81] Judge Shoob granted $5.1 million; the appellate court reduced the award to $4.7 million. *Wells*, 788 F2d at 743, 747.

[82] *Federal Judges vs. Science*, NY Times A2 (Dec 27, 1986).

[83] *In re Bendectin Products Liability Litigation*, 624 F Supp 1212, 1218, 1221, 1222, 1236, 1248 (SD Ohio 1985).

wrenching testimony about individual injuries.[84] When the jury couldn't decide this matter, Judge Young directed a verdict for the defense.

Generally speaking, a jury required to make successive, independent calls on special interrogatories, rather than issue a single all-embracing verdict, may function somewhat more like a larger jury or a repeat decisionmaker—which is to say, more stably, moderately and predictably. Bifurcated or trifurcated trials have considerable promise. Requiring separate and explicit jury calls on cause, liability, ordinary damages and punitive damages will almost certainly help move the mean verdict toward the median.

Earlier still in the process, the courts can recapture control of the rules of scientific evidence. Clinical ecologists don't belong in court;[85] letting them in simply preys on the ignorance of some juries, and entices others to advance extra-legal agendas. One need not search far for rules to limit such things. Rehabilitating the *Frye* rule, and applying it with resolution and vigor, is an excellent place to start.

But even *Frye* cannot be expected to eliminate the junk science verdict tail. Research into the psychology and perception of risk establishes that "disagreements about risk should not be expected to evaporate in the presence of evidence. Strong initial views are resistant to change because they influence the way that subsequent information is interpreted. New evidence appears reliable and informative if it is consistent with one's initial beliefs; contrary evidence tends to be dismissed as unreliable, erroneous or unrepresentative."[86] There is, regrettably, little reason to hope that the instant education of juries in matters of health, safety and science is at all effective.

Modern lawyers, it is worth noting, place remarkably little faith in juries when the issue is one of legal expertise. We do not invite jurors to rule on questions of law after a few days of expert testimony on the finer points of insider trading or the Uniform Commercial Code. It flatters the intellect of lawyers, of course, to maintain that in matters of codes, the Uniform Commercial is

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[84] See also *Marder*, 630 F Supp at 1093, aff'd, *Wheelahan*, 814 F2d 655. Larry Rosenthal, *Trial Opens in First Major Legal Test of Widely Used Copper 7 IUD*, Associated Press (Nov 19, 1985).

[85] See, generally, Richard S. Cornfeld and Stuart F. Schlossman, *Immunologic Laboratory Tests: A Critique of the Alcolac Decision*, 4 Toxics L Rptr 381 (1989).

[86] Paul Slovic, *Perception of Risk*, 236 Science 280, 281 (1981). See, generally, Richard E. Nisbett and Lee Ross, *Human Inference: Strategies and Shortcomings of Social Judgment* (Prentice Hall, 1980).

more difficult than genetic, that mastering the laws of Man requires higher intellect than mastering the laws of Nature. But it is doubtful that this is in fact true.

Imagine a civil justice system in which trials are conducted with no role at all for the one, neutral legal expert: the judge. Trials in which juries would simply be educated by contending experts on issues of law just as on issues of fact, and would rule on both by majority vote. We would not expect the system to be the least bit just or predictable. We would expect, instead, the most embarrassing misunderstandings of legal principle, and wildly divergent rulings from one courtroom to the next. We would expect to find expert witnesses on points of law pulled from the extreme poles of the debate. It would be a fine spectacle, no doubt. But not something one could easily label "justice."

It has been suggested that we need neutral judges of one sort or another to decide tough questions of science, just as we use judges to decide questions of law. The proposals range from court-appointed experts to blue-ribbon juries to science courts. Whatever may be said in favor of these various ideas, they have made notably little headway in practice. There are simpler and more familiar solutions at hand. The simplest is to restore to the law *per se* rules and stopping points that allow juries to decide cases without ruling on science at all.

Some of these solutions are familiar and cherished in the more-liability-is-better school of thinking. If the FDA declares that thalidomide is a teratogen and bans its use by pregnant women, there will not be a very long or complex trial if a company nonetheless sells the product and a child is born without arms. Why is the case so easy? Not just because the science is easy—birth defects, including missing digits or limbs, are tragically common with or without Thalidomide. The case is easy because all the difficult questions have already been decided outside the courtroom. There is a mainstream scientific consensus, the evidence has been reviewed by the FDA, there is agreement on the teratogenic properties of thalidomide, and that's the end of the matter. All of the same things can be said about Bendectin, yet Bendectin is off the U.S. market. Merrell-Dow Pharmaceuticals was bled white defending itself against junk claims; even when it won, it lost enormous legal fees, and now and again it lost a great deal more, good science notwithstanding. Bendectin was, all in all, a sorry spectacle, a vision of our modern liability system at its worst. And this despite the fact that to the 99th percentile jury verdicts have completely exonerated the manufacturer. Getting the right outcome with

thalidomide is easy, and getting the wrong one with Bendectin is too, because all the extrinsic and objective standards—contract and warranty, FDA rules, consensus in the mainstream scientific community, customary industry practice—can be engaged quickly, efficiently, and with all-but-certain result only to impose liability. Never to cut it off at the threshold.

The best way to reduce junk science verdicts, then, is to reduce the amount of science that juries must decide for themselves. For good reason, we don't invite juries to decide law; we only allow them to apply simple facts to the legal standards set before them by others, most notably independent experts in the law seated on the bench, not in the witness box. The Bendectin episode could have been avoided in much the same way, not by educating the judge, nor by searching for the right person to seat in the jury box, but by giving real weight to expert, mainstream, scientific judgments already reached outside the courtroom.

What then should a court do when a nuisance action is brought against an AIDS hospice, on the theory that AIDS is highly contagious and that nearby residents are scared to death of the peril? Much the same as it should do in the next Bendectin case, or the next trauma-cancer claim, or the next Audi sudden acceleration trial. We have better sources of information—whether they are the FDA, the Center For Disease Control, or declarations by the mainstream medical community—than juries on the contagious properties of AIDS, and those sources should be entirely dispositive on the science. Not because the jury cannot understand difficult science. But because there is no such thing as "the jury." Judges and legal academics speak much too freely about this undefined panel of six or 12, most often to praise it, now and again in the vain hope of burying it. In civil cases, when standards of scientific evidence are loose and burdens of proof light, the only intelligent response to sweeping generalities about "the jury" is to ask: Which one? The median or the mean? With junk science on the table in civil litigation, that difference is all the difference in the world.